Results from the City of Longmont's Greenhouse Gas Reduction Modeling

March 2019

lotus
engineering & sustainability

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Executive Summary

The City of Longmont's (Longmont) long-term sustainability vision is to improve the quality of life for all Longmont citizens and businesses by implementing sustainability initiatives that reduce greenhouse gas (GHG) emissions and provide equitable access for all members of the community.

To better understand Longmont's opportunity to reduce GHG emissions, Longmont contracted with Lotus Engineering and Sustainability, LLC (Lotus) to create a 2016 GHG emissions inventory and model the GHG emission reduction potential of various sustainability strategies. The aggregate of these modeled GHG emissions savings will be used to set a community-wide GHG emission reduction target, which will help Longmont work towards its sustainability vision.

Results from Longmont's 2016 GHG emissions inventory showed that the City emits 1,081,173 metric tons of carbon dioxide equivalent ($mtCO_2e$), of which 82 percent is derived from "core" sources. Core sources can be impacted by City-lead sustainability strategies and include emissions from: electricity, natural gas, gasoline, and oil wells. The 2016 core GHG emission value is 882,422 $mtCO_2e$.

Longmont identified 12 sustainability strategies that simultaneously reduce core GHG emissions while promoting significant co-benefits deemed to be critical to Longmont's sustainability vision, refer to Table ES - 1.

Sector	Objective	Specific Strategy	GHG Emission Reduction Potential	Promote Environmental Justice	Reduce Low- to Moderate-Income Energy Burden	Improve Public Health	Reduce Costs for End Users	Build Economic Development	Prevent Pollution
Building Energy	Implement deep carbon reductions in existing buildings	Use updated building code and enforce	Med		X	X	X	X	X
		Develop 'beyond' building code	Med		X	X	X	X	X
		Report and benchmark energy use	Med			X	X	X	X
		Perform commercial retro-commissioning	Med			X	X	X	X
	Expand income-qualified energy efficiency programs	Expand low-income energy efficiency programs	Med	X	X	X	X	X	X
Electric Grid	Develop smart grid projects	Accelerate and implement smart grid projects	Med		X	X	X	X	X
	Reduce grid transmission and distribution loss	Encourage practices that reduce transmission and distribution losses	Med			X		X	X
Renewable energy	Expand renewable energy	Develop a comprehensive 100% renewable energy plan for Longmont's just transition to a clean energy economy	High	X		X		X	X
Oil and Gas	Encourage regulations and policies that reduce oil and gas impacts	Adopt and enforce leak detection and repair	Low	X		X		X	X
Transportation	Increase the adoption of electric vehicles	Increase electric vehicles through vehicles incentives and improved infrastructure	High	X		X		X	X
	Reduce single-occupancy vehicle travel	Address barriers to increase access and use of public transit, especially for underserved communities	Low	X	X	X	X	X	X
		Develop multimodal transportation system	Low	X	X	X	X	X	X

Table ES - 1. GHG Emission Reduction Strategies' Potential Community Co-Benefits

If all strategies were pursued, Longmont could reduce its core GHG emissions by approximately 63 percent in 2030 and could reduce its core GHG emissions by approximately 65 percent in 2050 (both estimates are based on a 2016 core emission baseline). Figure ES - 1 shows 2050 GHG Emission Totals.

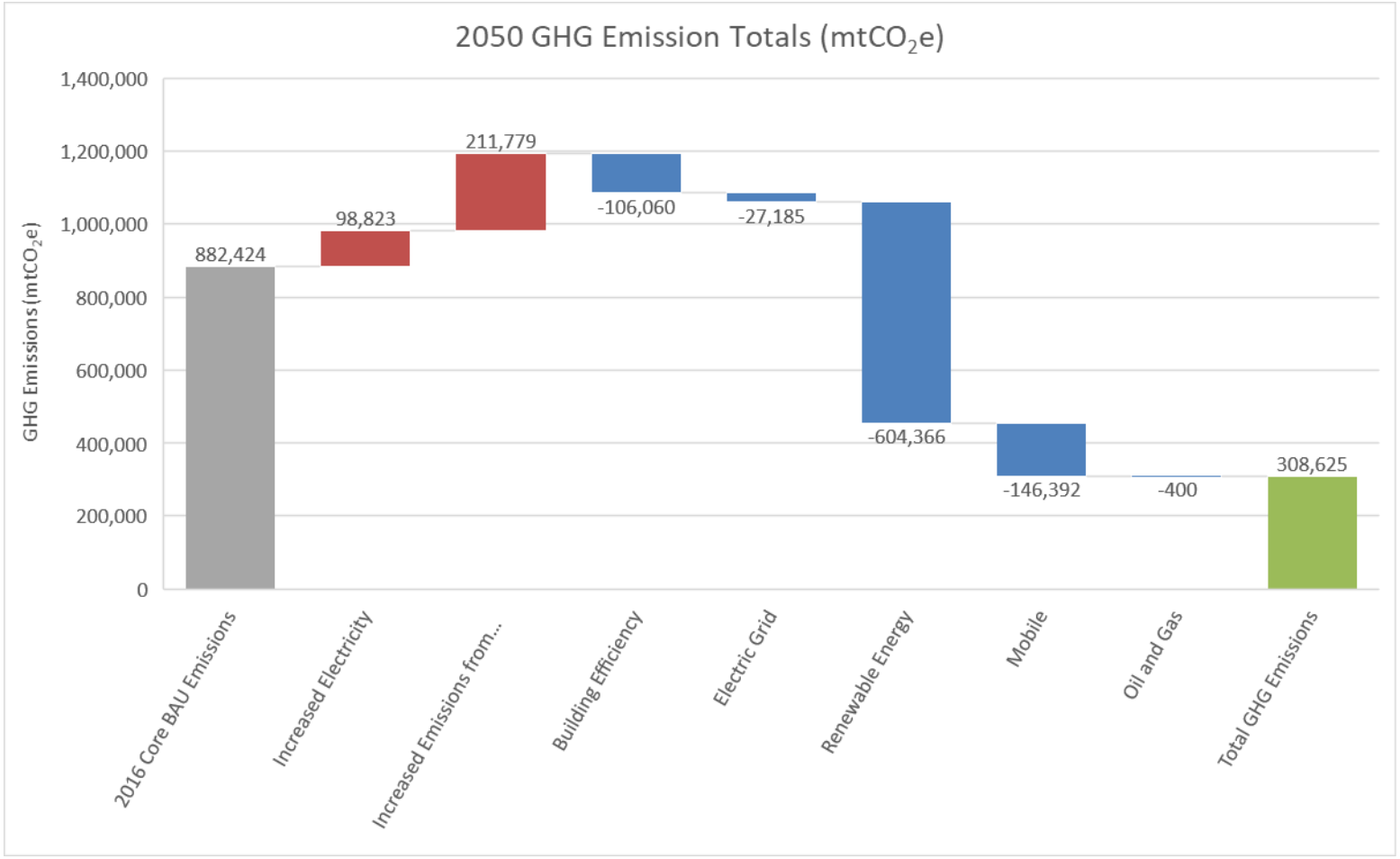

Figure ES - 1. 2050 Projected Core GHG Emissions

In addition, the City could reduce total GHG emissions in 2030 by approximately 48 percent and total GHG emissions in 2050 by 45 percent (See Figure ES - 2). The decrease in the percent reduction from 2030 to 2050 reflects impacts from an increased population (and therefore activity data) for sources that are not captured within the "core" category.

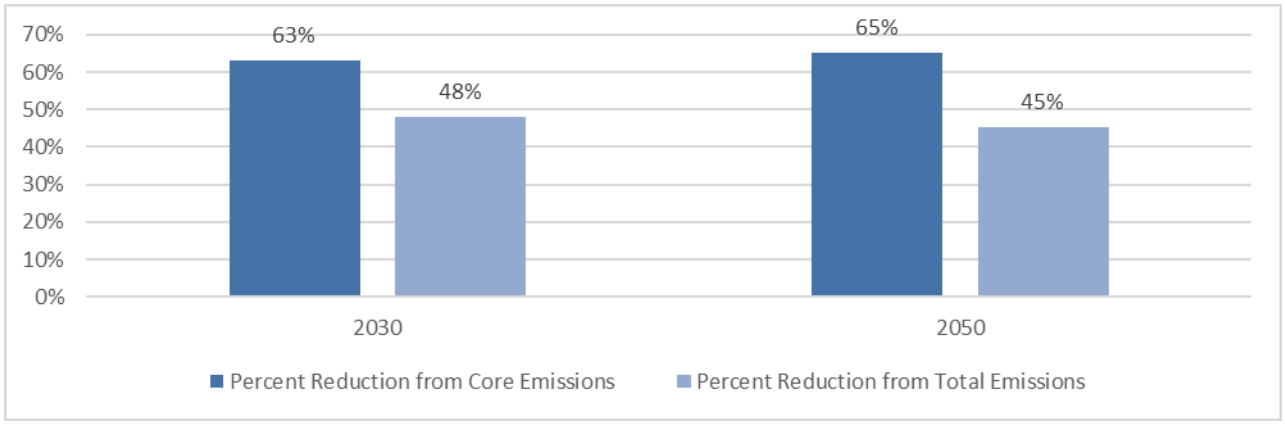

Figure ES - 2. Projected Core and Total GHG Emission Reductions

Introduction

Objective

The City of Longmont's (Longmont) long-term sustainability vision is to improve the quality of life for all Longmont citizens and businesses by implementing sustainability initiatives that reduce greenhouse gas (GHG) emissions and provide equitable access for all members of the community. To understand how and where there is opportunity, Longmont developed a list of key sustainability strategies and modeled the associated GHG emission reduction potential of each. When implemented together, the aggregate GHG emission reduction potential will inform (or become) a community-wide GHG emission reduction target that will help Longmont achieve its long-term sustainability vision.

Background

Longmont contracted with Lotus Engineering and Sustainability, LLC (Lotus) to develop a 2016 GHG emissions inventory and model the GHG emission reduction potential of various sustainability strategies.

The 2016 GHG emission inventory was conducted in accordance with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). Following completion of the inventory, Lotus worked with Longmont to develop a list of recommended GHG reduction strategies based on extensive research and City staff feedback. In addition to reducing GHG emissions, the strategies were selected to promote secondary benefits that have been deemed desirable by City staff and stakeholders. Refer to Appendix A, *Memo: Methodology to determine top GHG reduction strategies for the City of Longmont*, for more information.

These strategies were later vetted through a stakeholder process via an online survey that collected feedback from City staff and community representatives. Refer to Appendix B for a summary of survey results.

Lotus modeled the final list of recommended strategies for their estimated GHG reduction potential and worked with Longmont to develop a community-wide GHG reduction target. Refer to the spreadsheet titled *Longmont GHG Modeling Spreadsheet_Mar2019_REVISED*.

Longmont will later use this data to solicit feedback during an open workshop with a broader stakeholder audience, which will eventually lead to a comprehensive sustainability action plan.

Longmont's 2016 GHG Emissions

Longmont's 2016 GHG emission inventory showed a total GHG emissions value of 1,081,173 metric tons of carbon dioxide equivalent ($mtCO_2e$), the unit by which global GHG reporting is conducted. Approximately 82 percent of Longmont's emissions are from "core" emissions, which include emissions from electricity, natural gas, gasoline, and oil wells (See Table 1 below). Core emissions are shown in **bold.** These emission sources have the greatest potential to reduce Longmont's overall carbon footprint. For detailed information refer to the spreadsheet titled *Final_City of Longmont 2016 GHG Inventory Workbook.*

Table 1. City of Longmont's 2016 *Core* Emission Contributions

All Emissions by Source		
Emission Source	Emissions (mt CO_2e)	Percentage of Total
Electricity	**540,834**	**50.02%**
Natural Gas	**196,482**	**18.17%**
Oil Wells	**2,379**	**0.22%**
Stationary Diesel	2,068	0.19%
On-Road Transportation from Gasoline Vehicles	**143,870**	**13.31%**
On-Road Transportation from Diesel Vehicles	28,951	2.68%
On-Road Transportation from Electric Vehicles	47	0.004%
Railways	37	0.003%
Aviation	143,075	13.23%
Solid Waste	21,074	1.95%
Wastewater	588	0.05%
Refrigerant	1,142	0.11%
Land Management	626	0.06%
Total	**1,081,173**	**100%**

It should be noted that aviation also produces a significant amount of GHG emissions; however, since these emissions cannot be easily reduced by City policies or programs these emissions were excluded from the core definition. In addition, though the contribution from oil wells is relatively small, it is highly likely that methane emissions from oil and gas wells are significantly underestimated[1], and Longmont requested that oil and gas emissions be included as part of its core emissions.

[1] Recent data from University Corporation for Atmospheric Research (UCAR) suggests that the traditional method to estimate methane emissions from oil and gas wells may be significantly underestimated. UCAR has found that the "fingerprint" of methane from the oil and gas industry is much greater in the atmosphere than originally thought. Furthermore, emission factors typically used to calculate emissions from oil and gas are questioned within the industry. Additional research on the impacts of

Longmont's GHG Emission Reduction Potential

Longmont identified 12 key sustainability strategies that have the greatest potential to reduce GHG emissions, while promoting community co-benefits as shown in Table 2. These strategies fall under five sectors: building energy, electric grid, renewable energy, oil and gas, and transportation. Each sector has associated objectives and projected targets for reduction within that sector. Strategy definitions are based off industry best practices and are tailored based on existing actions underway by the City. In some cases, strategies may overlap or may be dependent on one another. Duplicative reductions were not removed.

oil and gas methane emissions is expected to be available within the next few years and may result in significant increases to GHG emission contributions from the oil and gas sector.

Table 2. List of Key Sustainability Strategies

Sector	Objective	Target	Specific Strategy	Definition	Potentially Overlapping Strategies
Building Energy	Implement deep carbon reductions in existing buildings	Reduce energy consumption in buildings by 16% by 2030	Use updated building code and enforce	Adopt and enforce the latest IECC every year a new IECC is released.	
			Develop 'beyond' building code	Develop building codes that go beyond the IECC and towards net-zero energy use.	
			Report and benchmark energy use	Requires commercial and industrial buildings owners whose buildings exceed 20,000 square feet to rate their building's energy use, report energy metrics, and encourages buildings owners to implement energy efficiency measures.	
			Perform commercial retro-commissioning	Perform retro-commissioning in buildings greater than 20,000 square feet once every 10 years.	
	Expand income-qualified energy efficiency programs		Expand low-income energy efficiency programs	Involve all qualifying households in a comprehensive income-qualified energy efficiency program.	Use updated building code and enforce
Electric Grid	Develop smart grid projects	Reduce electricity consumption by 5% by 2030	Accelerate and implement smart grid projects	Implement a variety of smart grid projects that encourage reductions in electricity consumption through real-time feedback, dynamic pricing, etc. LPC is currently conducting a small test pilot of AMR/AM in 2018 and 2019. This would potentially lay the framework to employ future demand-response programs and dynamic utility rate structures.	
	Reduce grid transmission and distribution loss		Encourage practices that reduce transmission and distribution losses	Reduce electric grid transmission and distribution losses through grid management such as distributed voltage optimization. It should be noted that LPC's electric grid is efficient. From LPC: Longmont Power & Communications currently enjoys a system wide power factor of 0.999 during cooler months and greater than 0.95 during the warm summer months. LPC also employs capacitor banks throughout the distribution network to improve voltage support.	
Renewable energy	Expand renewable energy	Increase renewable energy generation to 100% by 2030	Develop a comprehensive 100% renewable energy plan for Longmont's just transition to a clean energy economy	Acquire all electricity from renewable energy sources by 2030.	
Oil and Gas	Encourage regulations and policies that reduce oil and gas impacts	Reduce oil and gas methane emission leaks 60% by 2027	Adopt and enforce leak detection and repair	Improve monitoring of oil and gas sites by increasing methane leak detection and repair and minimizing leaks in the transmission and distribution system of natural gas.	
Transportation	Increase the adoption of electric vehicles	Reduce mobile fuel consumption by 33% by 2050	Increase electric vehicles through vehicle incentives and improved infrastructure	Increase the rate of electric vehicle adoption until a majority of vehicles are powered by clean electricity.	Develop a comprehensive 100% renewable energy plan for Longmont's just transition to a clean energy economy
	Reduce single-occupancy vehicle travel		Address barriers to increase access and use of public transit, especially for underserved communities	Increase public transit through the City's Ride Free Program.	Develop multimodal transportation system
			Develop multimodal transportation system	Pursue all elements of Longmont's multimodal transportation plan. Actively reduce greenhouse gas emissions through bicycle and pedestrian improvements and first/last mile connections.	Address barriers to increase access and use of public transit, especially for underserved communities

It should be noted that there is a direct relationship between increasing renewable energy and all strategies that increase or decrease the use of electricity, in particular the addition of electric vehicles.

Community-Wide Target

If all strategies were to be implemented, Longmont can expect to achieve a GHG emission reduction of approximately 63 percent of core emissions in 2030 and a GHG emission reduction of 65 percent in 2050 (both estimates are based on a 2016 core emission

baseline) (see Figure 1 and Figure 2). The 2016 GHG core emission value was 882,422 $mtCO_2e$, the 2030 projected GHG core emission value is 325,655 $mtCO_2e$, and the 2050 projected GHG core emission value is 308,625 $mtCO_2e$.

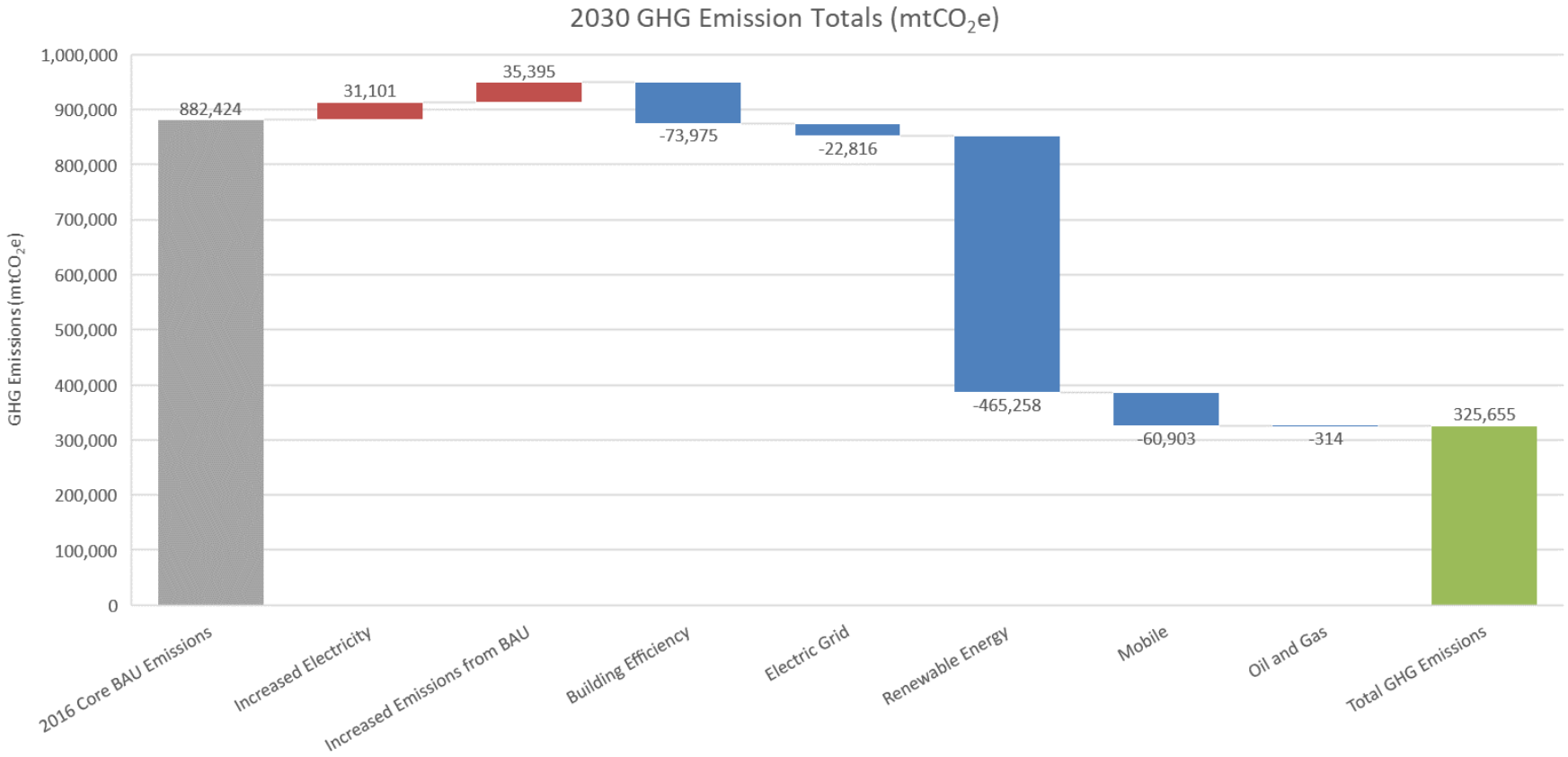

Figure 1. 2030 Projected Core GHG Emissions

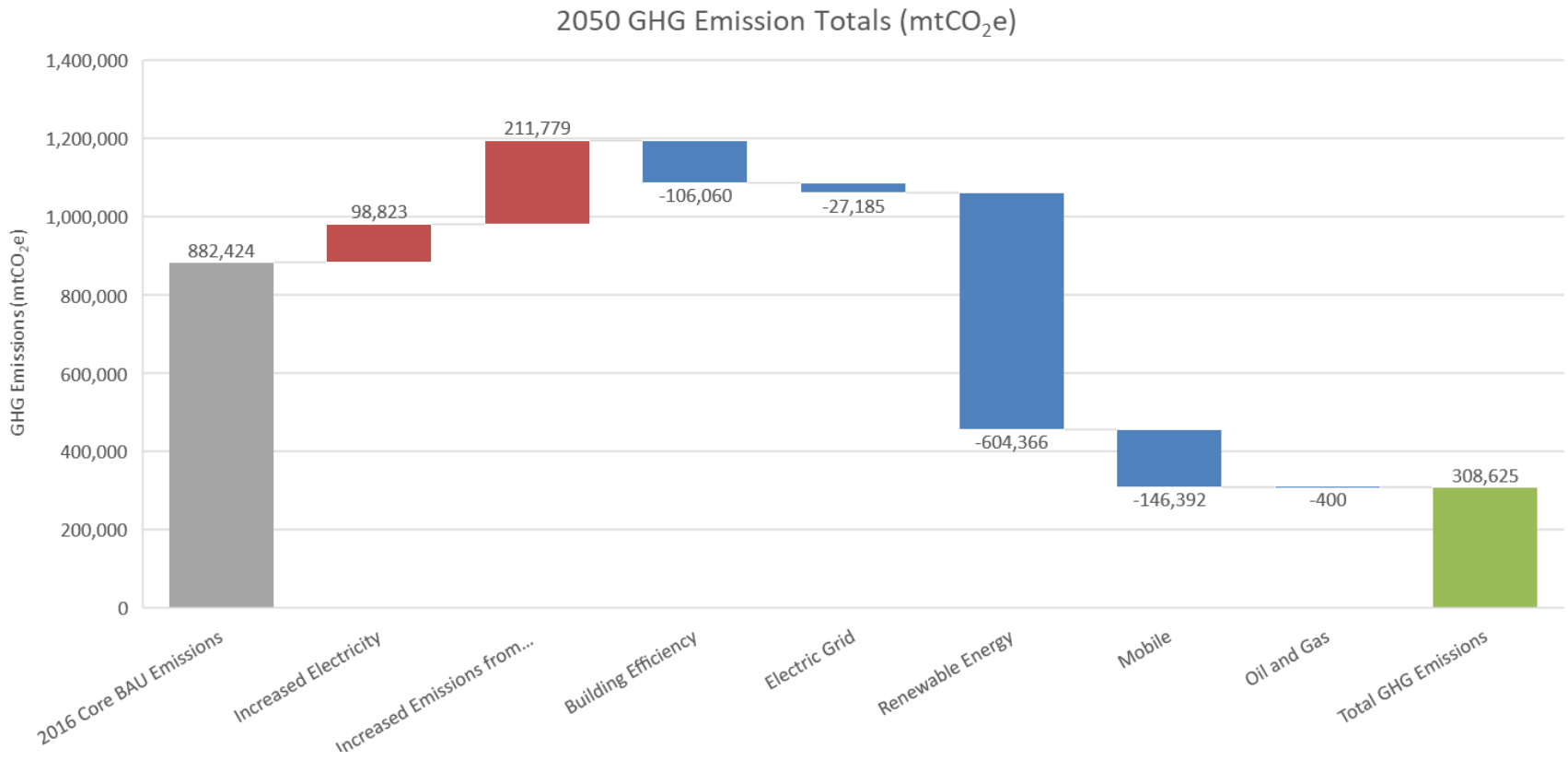

Figure 2. 2050 Projected Core GHG Emissions

The largest contribution in GHG emission reductions comes from renewable energy, which must overcome electricity consumption not already offset by efficiency measures and additional electricity put on to the grid from electric vehicles. The next largest contribution comes from building efficiency, followed by mobile (i.e. transportation), electric grid improvements, and oil and gas.

It should be noted that the contributions from each sector (and therefore strategy) are highly dependent on data inputs and data assumptions.

Because the inputs used in this estimation tool are specific to Longmont and further assumptions were derived during multiple conversations and through stakeholder feedback, comparing the results of this model to other communities should be proceeded with care. Likewise, the assumptions used in the model predict the potential reductions in GHG emissions, and they also dictate the level of resources required by each initiative. If assumed inputs, such as participation or assumed savings values, do not occur, then the potential for GHG emission reductions will change accordingly. Data inputs and assumptions can be adjusted in the spreadsheet titled *Longmont GHG Modeling Spreadsheet_Mar2019_REVISED*, which will produce revised projections for GHG emission reductions.

GHG Savings Over Time

The impact of GHG emission reduction potential over time is shown in Figure 3. If Longmont does not pursue any sustainability strategies, its GHG emissions will increase over time and will be affected by changes in population, emission factors, and other exogenous factors. This is shown as the Business-As-Usual (BAU) projection. Each colored "wedge" represents the amount of savings predicted by a specific sector, with GHG emission savings from renewable energy dominating the potential for savings. The difference between the BAU and the cumulative GHG savings from all strategies is shown as "Remaining Emissions".

The GHG emission reductions shown in Figure 3 represent the potential if all sustainability strategies were pursued. The tab titled "Strategy Selection" in the spreadsheet titled *Longmont GHG Modeling Spreadsheet_Mar2019_REVISED* allows the user to de-select certain strategies, creating different wedges of savings and a different "Remaining Emissions" forecast.

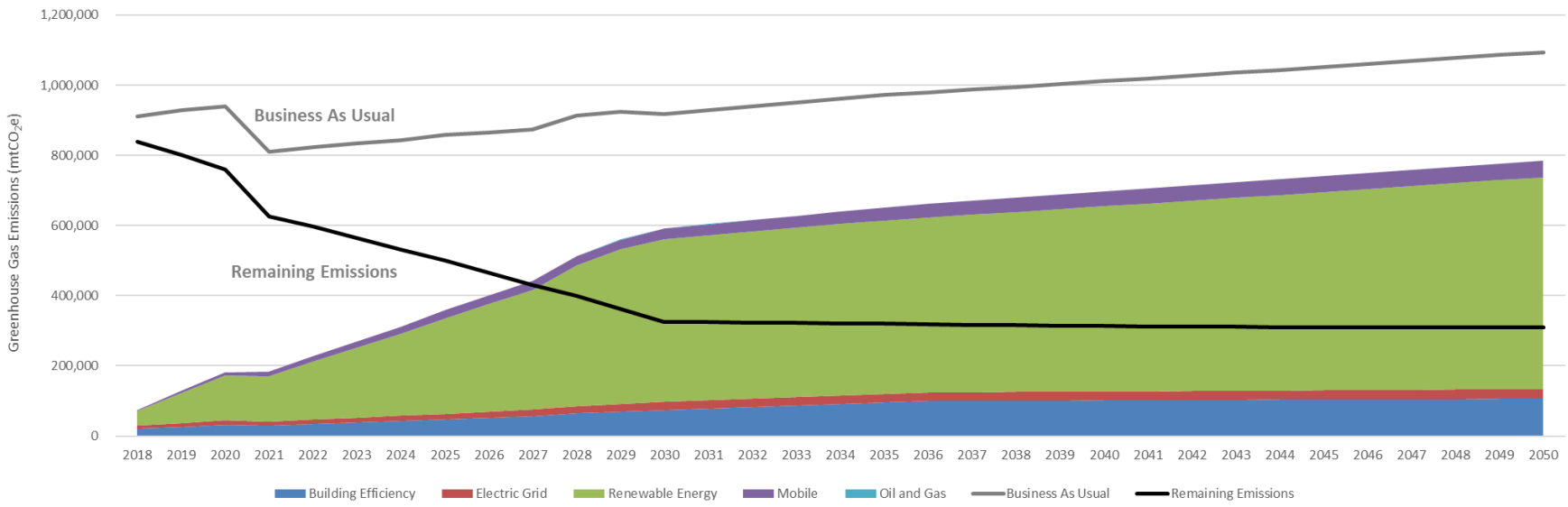

Figure 3. Core GHG Emission Reduction Potential Over Time

The step change occurring in 2020 in Longmont's BAU projection is a result of projected changes in Longmont Power and Communication's (LPC) electricity emission factor. Data from Platte River Power Authority (PRPA) shows that the electricity emission factor is projected to decrease from 1,497 pounds (lbs) per mega-watt hour (MWh) in 2020 to 1,132 lbs per MWh in 2021 based on the addition of wind energy. Since GHG emissions from electricity make up approximately 50 percent of Longmont's total core GHG emissions (see Table 1), any changes made to electricity derived GHG emissions makes a significant change to Longmont's total core emissions. See *Longmont GHG Modeling Spreadsheet_Mar2019_REVISED* for more information.

It should also be noted that in December 2018, Xcel Energy, which provides approximately 0.06 percent of Longmont's electricity, committed sourcing 80 percent of its electricity from carbon-free sources by 2030 and 100 percent of its electricity from carbon-free sources by 2050. Also, in December 2018, PRPA has made a similar commitment to source 100 percent of its electricity from carbon-free sources by 2030. The business-as-usual projection in Figure 3 includes the updated Xcel Energy electricity emission factors but does not include PRPA's. Please see the section *General Impacts from Electricity Emission Factors* below for more information.

Many of the strategies were expected to reach their full potential of participation and/or savings in the year 2030; therefore, there is a steep incline of potential savings from 2018 until 2030 and the savings begin to incline at a more gradual rate from 2030 to 2050.

Strategy Co-Benefits

The 12 key sustainability strategies identified by Longmont will not only reduce GHG emissions but also have the potential to promote valuable community co-benefits. Six community co-benefits were identified and vetted through stakeholder feedback and they include the following list.

1. Promote environmental justice: Help vulnerable populations reach greater equity with non-vulnerable populations.
2. Reduce low- to moderate-income (LMI) energy burden: Reduce the ratio of money spent on energy bills versus total income.
3. Improve public health and air quality: Reduce the emissions of toxic air and water contaminants (particularly indoors) and chemical exposure and improve health and safety.
4. Reduce costs for end users: Regardless of the initial implementation cost, reduce final costs to the end-user.
5. Build economic development: Bring outside dollars into the community and/or encourage the community to invest their money into the local workforce and businesses.
6. Prevent pollution: Reduce waste generation, emitted pollutants, and potentially related toxicity.

A comparison of the modeled GHG emission reduction potential against the effects on co-benefits is presented in Table 3.

The relative scale of GHG emission reduction impact is defined as: Low - 0 to 5,000 $mtCO_2e$ annual savings, Med - 5,001 to 10,000 $mtCO_2e$ annual savings, and High - 10,001+ $mtCO_2e$ annual savings occurring in the year 2050.

Table 3. Comparison of GHG Emission Reduction Potentials Against Community Co-Benefits

Sector	Objective	Specific Strategy	GHG Emission Reduction Potential	Promote Environmental Justice	Reduce Low- to Moderate-Income Energy Burden	Improve Public Health	Reduce Costs for End Users	Build Economic Development	Prevent Pollution
Building Energy	Implement deep carbon reductions in existing buildings	Use updated building code and enforce	Med		X	X	X	X	X
		Develop 'beyond' building code	Med		X	X	X	X	X
		Report and benchmark energy use	Med			X	X	X	X
		Perform commercial retro-commissioning	Med			X	X	X	X
	Expand income-qualified energy efficiency programs	Expand low-income energy efficiency programs	Med	X	X	X	X	X	X
Electric Grid	Develop smart grid projects	Accelerate and implement smart grid projects	Med		X	X	X	X	X
	Reduce grid transmission and distribution loss	Encourage practices that reduce transmission and distribution losses	Med			X		X	X
Renewable energy	Expand renewable energy	Develop a comprehensive 100% renewable energy plan for Longmont's just transition to a clean energy economy	High	X		X		X	X
Oil and Gas	Encourage regulations and policies that reduce oil and gas impacts	Adopt and enforce leak detection and repair	Low	X		X		X	X
Transportation	Increase the adoption of electric vehicles	Increase electric vehicles through vehicles incentives and improved infrastructure	High	X		X		X	X
	Reduce single-occupancy vehicle travel	Address barriers to increase access and use of public transit, especially for underserved communities	Low	X	X	X	X	X	X
		Develop multimodal transportation system	Low	X	X	X	X	X	X

Contributions from Different Strategies

Contributions from each strategy in 2030 and 2050 are shown in Table 4.

Table 4. Potential Core GHG Emissions Reductions by Strategy in 2030 and 2050

Strategy	GHG Emission Reduction Potential ($mtCO_2e$) in 2030	GHG Emission Reduction Potential ($mtCO_2e$) in 2050
1. Use updated building code and enforce	9,646	14,860
2. Develop 'beyond' building code	29,525	51,786
3. Report and benchmark energy use	10,176	10,175
4. Perform commercial retro-commissioning	12,361	14,622
5. Expand low-income energy efficiency programs	12,267	14,617
6. Accelerate and implement smart grid projects	15,210	18,123
7. Encourage practices that reduce transmission and distribution losses	7,605	9,062
8. Total electricity needed to be generated to meet 100% RE goal	465,258	604,366
9a. Increase electric vehicles through vehicles incentives and improved infrastructure (savings from gasoline)	48,965	120,281
9b. Increase electric vehicles through vehicles incentives and improved infrastructure (additions from electricity)	(31,101)	(98,823)
10. Address barriers to increase access and use of public transit, especially for underserved communities	307	284
11. Develop multimodal transportation system	11,631	25,827
12. Encourage regulations and policies that reduce oil and gas impacts	314	400
TOTAL	**592,164**	**785,579**

A detailed outline of key data assumptions by strategy is presented in the following sections. Further detail and the source of each assumption can be referenced in the corresponding tab in the spreadsheet titled *Longmont GHG Modeling Spreadsheet_Mar2019_REVISED.*

General Impacts from Electricity Emission Factors

As noted in the section *GHG Savings Over Time*, electricity emission factors play a big part in determining overall GHG emissions since GHG emissions from electricity are responsible for approximately 50 percent of Longmont's core emissions (Table 1). Unfortunately, electricity emission factors are very difficult to predict. Longmont's electricity is provided by two sources: LPC and Xcel Energy. LPC provides approximately 99.94 percent of all residential and commercial electricity, whereas Xcel Energy provides the remaining amount (see the tab titled "Emission Factors and Constants in the spreadsheet titled *Longmont GHG Modeling Spreadsheet_Mar2019_REVISED* for more information).

PRPA is LPC's wholesale electricity provider and provided electricity emission factor projections to Longmont. Emission factors between 2018 and 2030 were provided by PRPA and consider varying mixes of fossil fuels and renewable energy expected by PRPA. A significant decrease is expected in 2020 after PRPA adds 150 MW of wind generation.

In December 2018, PRPA made a commitment to source 100 percent of its energy from carbon-free sources. If PRPA were to meet this commitment, the business-as-usual emissions from electricity and the GHG emission savings from strategies that reduce electricity would be minimal since both would be based off an electricity emission factor of 0 lbs per MWh. However, discussions with PRPA indicate that PRPA will only meet this goal if certain policies are enacted, certain technologies become widely available and accessible, and electricity savings from demand-side management (DSM) programs are abundant. As one of PRPA's primary members, reductions in Longmont's electricity use are essential to ensure that PRPA can acquire enough renewable energy and other carbon-free sources to offset electricity consumption. Based on PRPA's continually evolving roadmap to 100 percent renewable energy and Longmont's critical role, PRPA requested that its initial emission factor projections (which were provided to Longmont prior to the 100 percent carbon-free commitment announcement) be used to model the business-as-usual projection and GHG emission savings associated with electricity reduction strategies.

Xcel Energy provided emission factor estimates from the present until 2021. After 2021, emission factor projections are based off a constant reduction that would be needed to meet Xcel Energy's carbon commitments: 80 percent reduction in emissions by 2030 and 100 percent reduction in emissions by 2050. Xcel Energy provided this calculation guidance to Longmont.

Building Efficiency

The building efficiency sector includes five strategies. When implemented together, these strategies are expected to reduce building related 2016 GHG emissions by 16 percent by 2050 and total core emissions by 12 percent.

1. Use updated building code and enforce
2. Develop "beyond" building code
3. Report and benchmark energy use
4. Perform commercial retro-commissioning
5. Expand low-income energy efficiency programs

All strategies assume that a building's energy consumption is 50 percent electricity and 50 percent natural gas.

Use updated building code and enforce

This strategy requires that Longmont update and enforce the latest version of the International Energy Conservation Code (IECC) every cycle (which is projected to occur every three years). It affects both new construction and existing construction that triggers building codes.

Data assumptions used to calculate GHG emission reductions include:

- 90 percent commercial and residential building code compliance rate;
- 1 percent annual increase in square footage for new residential and commercial buildings;
- 1 percent annual increase in major remodels and/or renovations in existing residential and commercial buildings that trigger adoption of a new building code;
- 5 percent increase in residential efficiency with each updated version of the IECC; and
- 11 percent increase in residential efficiency with each new version of the IECC.

In 2050, this strategy is expected to save 20,061,278 kilowatt-hour (kWh), 793,718 therms, and 14,862 $mtCO_2e$. This is projected to result in 2050 core and building sector GHG emission values that are approximately 2 percent less than the 2016 emission baseline.

Develop "beyond" building code

This strategy requires that Longmont implement a building code that achieves energy savings beyond what is required by the standard IECC. It is modeled to assume that new residential and commercial buildings will be net-zero energy in 2030.

Data assumptions used to calculate GHG emission reductions include:

- incremental increase in savings over the IECC until 2030, at which point all new construction will be net-zero energy and have an energy use index (EUI) of 0.

In 2050, this strategy is expected to save 65,644,439 kWh, 3,191,628 therms, and 51,792 $mtCO_2e$. These savings are in addition to "Use updated building code and enforce". This is projected to result in 2050 core and building sector GHG emission values that are approximately 6 and 9 percent less than the 2016 emission baseline, respectively.

Report and benchmark energy use

This strategy requires that all commercial and industrial buildings owners whose buildings exceed 20,000 square feet rate their building's energy use and report energy metrics. It also encourages buildings owners to implement energy efficiency measures.

Data assumptions used to calculate GHG emission reductions include:

- 9.6 percent reduction in overall energy consumption whereas savings are spread over 10 years;
- 85 percent adoption rate;
- total square footage of buildings exceeding 20,000 in 2016 is equal to 10,798,212; and
- savings only applies to existing buildings, savings from new buildings will be captured with the "Develop 'beyond' building code" strategy.

In 2050, this strategy is expected to save 15,105,575 kWh, 406,873 therms, and 10,176 $mtCO_2e$. This is projected to result in 2050 core and building sector GHG emission values that are approximately 1 and 2 percent less than the 2016 emission baseline, respectively.

Perform commercial retro-commissioning

This strategy requires that all commercial and industrial buildings owners perform retro-commissioning in buildings greater than 20,000 square feet.

Data assumptions used to calculate GHG emission reductions include:

- total square footage of buildings exceeding 20,000 in 2016 is equal to 10,798,212;
- 16 percent reduction in energy consumption in new buildings;
- 13 percent reduction in energy consumption in new buildings; and
- 50 percent participation rate.

In 2050, this strategy is expected to save 21,707,681 kWh, 584,703 therms, and 14,624 $mtCO_2e$. This is projected to result in 2050 core and building sector GHG emission values that are approximately 2 percent less than the 2016 emission baseline.

Expand low-income energy efficiency programs

This strategy requires that Longmont involve income-qualified households in a comprehensive energy efficiency program.

Data assumptions used to calculate GHG emission reductions include:

- annual GHG emissions savings of 2.65 $mtCO_2e$, whereas 50 percent of electricity is saved, and 50 percent of natural gas is saved;
- annual electricity savings of 1,950 kWh;
- annual natural gas savings of 250 therms; and
- 30 percent participation rate by 2030, with incremental increases in participation until 2030.

It should be noted that the estimate of participation rates may be high; many other communities implementing similar program see lower participation rates, and this rate may overestimate the savings potential.

In 2050, this strategy is expected to save 12,059,906 kWh, 1,546,142 therms, and 14,617 $mtCO_2e$. This is projected to result in 2050 core and building sector GHG emission values that are approximately 1.7 and 2.0 percent less than the 2016 emission baseline, respectively.

Electric Grid

The electric grid sector includes two strategies. When implemented together, these strategies are expected to reduce building related 2016 GHG emissions by 5 percent by 2050 and total core emissions by 3 percent.

1. Accelerate and implement smart grid projects
2. Encourage practices that reduce transmission and distribution losses

Accelerate and implement smart grid projects

This strategy encourages LPC and PRPA to implement a variety of smart grid projects that promote reductions in electricity consumption through real-time feedback, dynamic pricing, etc. LPC is currently conducting a small test pilot of advanced metering infrastructure (AMI) in 2018 and 2019. This would potentially lay the framework to employ future demand-response programs and dynamic utility rate structures.

Data assumptions used to calculate GHG emission reductions include:

- 10 percent reduction in electricity consumption; and
- 30 percent residential and commercial participation rate.

In 2050, this strategy is expected to save 34,170,861 kWh and 18,127 mtCO_2e. This is projected to result in 2050 core and building sector GHG emission values that are approximately 2 and 3 percent less than the 2016 emission baseline, respectively.

Encourage practices that reduce transmission and distribution losses

This strategy encourages LPC and PRPA to reduce electric grid transmission and distribution losses through grid management such as distributed voltage optimization. It should be noted that LPC considers their electric grid is very efficient, and there may not be room for additional improvement.

Data assumptions used to calculate GHG emission reductions include:

- 1.5 percent reduction in electricity consumption.

In 2050, this strategy is expected to save 17,085,431 kWh and 9,063 mtCO_2e. This is projected to result in 2050 core and building sector GHG emission values that are approximately 1 and 2 percent less than the 2016 emission baseline, respectively.

Renewable Energy

The renewable energy sector includes one strategy.

1. Develop a comprehensive 100% renewable energy plan for Longmont's just transition to a clean energy economy

The amount of renewables required to meet Longmont's objective was calculated as the difference between the amount of electricity consumed, the amount of renewable electricity currently generated, and the increase in electricity added to the grid through mobile fuel switching from gasoline-powered vehicles to electric vehicles.

When implemented, this strategy is expected to reduce total 2016 core GHG emissions by 69 percent. It should be noted that this percentage can be misleading: the 2050 value includes the amount of renewable energy needed to overcome increases in electricity and is compared to a 2016 baseline value that does not include additional electricity.

Develop a comprehensive 100% renewable energy plan for Longmont's just transition to a clean energy economy

This strategy requires that Longmont acquire all electricity from renewable energy sources by 2030.

Data assumptions used to calculate GHG emission reductions include:

- renewable energy has an electricity emission factor of 0; and
- 100 percent renewable energy will be achieved in 2030, with incremental increases in renewable energy until then.

In 2050, this strategy is expected to generate 1,143,390,523 kWh and save 606,533 mtCO_2e. This is projected to result in 2050 core and building sector GHG emission values that are approximately 69 and 112 percent less than the 2016 core emission baseline.

Transportation

The transportation sector includes three strategies. When implemented together, these strategies are expected to reduce transportation related 2016 GHG emissions by 33 percent by 2050 and total core emissions by 5 percent.

1. Increase electric vehicles through vehicle incentives and improved infrastructure
2. Address barriers to increase access and use of public transit, especially for underserved communities
3. Develop a multimodal transportation system

Increase electric vehicles through vehicle incentives and improved infrastructure

This strategy requires that Longmont increase the rate of electric vehicle adoption until most vehicles are powered by clean electricity.

Data assumptions used to calculate GHG emission reductions include:

- GHG emission reduction contribution from existing electric vehicles is negligible;
- 25 percent increase in electric vehicles by 2030, with incremental increases until then;
- 75 percent increase in electric vehicles by 2050, with incremental increases until then;
- conventional fuel efficiency will gradually decrease over time;
- average vehicle miles traveled per vehicle is 8,000;
- average fuel efficiency of electric vehicles is 0.34 kWh per mile;
- 81 percent of electric vehicles are charged at home and 19 percent are charged at businesses; and
- electricity for electric vehicles will be generated by renewable energy.

In 2050, this strategy is expected to save 13,383,287 gallons of gasoline and 120,281 $mtCO_2e$. Since this strategy is switching from gasoline to electricity, this strategy is also expected to add 186,328,548 kWh to the grid and, if this electricity is not powered by 100 percent renewable energy, this electricity could add 98,841 $mtCO_2e$. This is projected to result in 2050 core and transportation sector GHG emission values that are approximately 14 and 84 percent less than the 2016 emission baseline, respectively. It should be noted that the 2016 baseline emissions do not consider an increase in electricity, while the 2050 emission savings do.

Address barriers to increase access and use of public transit, especially for underserved communities

This strategy requires that Longmont increase public transit through the City's Ride Free Program.

Data assumptions used to calculate GHG emission reductions include:

- an initial annual increase in ridership of 105,686 that increases over time at the rate of population increase;
- annual vehicle miles traveled saved per boarding of 8.8; and
- conventional fuel efficiency will gradually decrease over time.

In 2050, this strategy is expected to save 31,569 gallons of gasoline and 284 $mtCO_2e$. This is projected to result in 2050 core and transportation sector GHG emission values that are approximately less than 1 percent less than the 2016 emission baseline.

Develop a multimodal transportation system

This strategy requires that Longmont pursue all elements of Longmont's multimodal transportation plan. Two actions will actively reduce GHG emissions: bicycle and pedestrian improvements and first/last mile connections, and these are quantified for their GHG emission reduction potential.

Data assumptions used to calculate GHG emission reductions include:

- current bicycling and walking mode share of 10 percent;
- bicycling and walking mode share target of 25 percent by 2050;
- conventional fuel efficiency will gradually decrease over time;
- average vehicle miles traveled per vehicle is 8,000;
- filling the gap of first/last mile connections could increase transit ridership by 3.5 percent;
- estimated annual ridership with Ride Free Program is 554,602; and
- annual vehicle miles traveled saved per boarding of 8.8.

In 2050, this strategy is expected to save 2,873,692 gallons of gasoline and 25,827 $mtCO_2e$. This is projected to result in 2050 core and transportation sector GHG emission values that are approximately 3 and 18 percent less than the 2016 emission baseline, respectively.

Oil and Gas

The oil and gas sector includes one strategy. When implemented, this strategy is expected to reduce total 2016 core GHG emissions by 0.05 percent.

1. Encourage regulations and policies that reduce oil and gas impacts

Encourage regulations and policies that reduce oil and gas impacts

This strategy requires that Longmont improve monitoring of oil and gas sites by increasing methane leak detection and repair (LDAR) and minimizing leaks in the transmission and distribution system of natural gas.

Data assumptions used to calculate GHG emission reductions include:

- 8 percent of total methane emissions are a result of leaks;
- LDAR can save 60 percent of methane emissions from leaks; and

- 100 percent participation rate by 2027, with incremental increases until then.

In 2050, this strategy is expected to generate 14 metric tons of methane ($mtCH_4$) and save 400 $mtCO_2e$. This is projected to result in 2050 core and oil and gas sector GHG emission values that are approximately 0.05 percent and 17 percent less than the 2016 emission baseline, respectively. It should be noted that conversations from a variety of oil and gas experts indicated that current data on oil and gas methane emissions is of poor quality. The most recent studies suggest that actual methane emissions from oil and gas could be three (or more) times greater than what can be quantified. Longmont is encouraged to revisit oil and gas methane emissions every few years to better understand the real potential from oil and gas.

Next Steps

This modeling effort does not capture all sustainability strategies that could be considered by Longmont as a part of a comprehensive sustainability action plan. Rather, it concentrates on those strategies that are expected to generate the most impact on core GHG emissions, while promoting Longmont's key co-benefits. Longmont could continue to explore qualitative strategies, existing efforts currently underway, and ambitious GHG emission reduction strategies that may not provide significant co-benefits.

Qualitative Strategies

Longmont has identified several qualitative strategies that will further enable Longmont to reduce its GHG emissions and provide ancillary benefits to its residents and businesses. These strategies may be pursued independently from one other, in groups, or all together.

1. Commit to a GHG reduction goal.
2. Commit to carbon neutrality goal.
3. Support clean energy policies to support a clean energy action agenda in Colorado.
4. Support state level action that will reduce carbon impacts.
5. Support state action to require the Public Utilities Commission to reduce carbon impacts from investor-owned utilities.
6. Support the development of clean energy options for all communities.
7. Build programs and policies that support Longmont's community that are disfranchised, vulnerable, and/or who may not be fluent in English.

8. Conduct outreach and education to build relationships, trust and to increase connections that will help develop more equitable access to all of Longmont's program and policies.

Each of these strategies will build resiliency with Longmont and support the modeled strategies. Longmont is encouraged to integrate these strategies where possible within Longmont's long-term sustainability vision.

Existing Efforts Not Modeled

Table 5 lists other GHG reduction strategies either underway or suggested to the City. These strategies were not modeled because they are not expected to significantly reduce GHG emissions and/or they were not expected to promote a significant number of co-benefits. However, these strategies are critical to a comprehensive sustainability strategy and should be pursued as part of the City's overall plan.

Table 5. Existing Efforts Underway by Longmont That Were Not Modeled

Strategy Being Pursued by Longmont	Strategy from Longmont Sustainability Plan	Target from Longmont Sustainability Plan	Strategy from Other Plans
Buildings Energy			
Implement/expand municipal resource efficiency efforts	1: Require life cycle cost and sustainability analyses for all City of Longmont projects and programs. 2: Review energy efficiency improvement and renewable energy generation opportunities for municipal facilities.	All City departments are using life cycle cost and sustainability evaluations for public projects by 2018.	
Renewable Energy			
Install/expand solar for all municipal buildings	Review energy efficiency improvement and renewable energy generation opportunities for municipal facilities.		
Develop a MSW gasification or waste-to-energy system			The City of Longmont is currently looking at waste methane from its WWTP.
Transportation			
Develop and implement a safe biking and walking trail network	Support growth in active transportation.		Connect links between bicycle and pedestrian facilities
Oil and Gas			
Diagnose and investigate emission sources and monitor air quality conditions			Monitor and reduce average annual 4th highest daily maximum ozone emissions to less than 70 ppb
Increase public access to local air quality information and actions the public can take	Expand air quality information and monitoring.	Increase public access to local air quality information and actions the public can take to improve air quality.	
Other			
Optimize soil carbon sequestration	Encourage and support the Boulder County Resource Conservation Board in pursuing carbon sequestration studies.	Carbon sequestration Targets TBD based on projects.	
Protect and expand tree canopy			Have 18% or more of Longmont Planning Area covered by, regionally appropriate, tree canopy or vegetation by 2025
Engage the public and educate about actions to combat climate change	Expand existing neighborhood programs to enhance sustainability, resiliency, and quality of life.	Expand existing neighborhood programs to address neighborhood sustainability by 2017.	
Consistently monitor and report progress (and benchmark)	Prepare a local greenhouse gas emissions baseline inventory and forecast.	Create baseline information for GHG emissions by 2018 and maintain ongoing reporting.	

Longmont is also pursuing a multimodal transportation system. The plan is robust and includes several strategies to improve transportation throughout the City, many of which will reduce GHG emissions directly or indirectly. Those strategies that will have direct and clear impact on GHG emissions were included in the GHG emission reduction model. Those strategies that may have an indirect contribution were not modeled but will be integrated to all transportation related operations throughout the community.

Phase 2

The information presented here and in the spreadsheet *Longmont GHG Modeling Spreadsheet_Mar2019_REVISED* shows a preliminary look at Longmont's GHG emission reduction potential. The City plans to use this data to solicit feedback on data inputs and assumptions during an open workshop with a broader stakeholder audience. This effort will help increase community buy-in and accountability and will eventually lead to a comprehensive sustainability action plan.

While Longmont solicits feedback on the data presented in the modeling effort, Longmont is also encouraged to explore additional strategies that will strengthen the City's GHG emission reduction potential:

- exploring options for increasing renewable energy (e.g. working with PRPA and LPC to reduce electricity emission factors, expand distributed generation, etc.);
- stationary fuel switching; and
- advocating for clean car policies.

Longmont's strategy, 100 percent commitment to renewable energy, dominates the potential for GHG emission savings (see Figure 4).

Figure 4. Emission Contributions by Sector

Longmont's weighted average electricity emission factor is expected to change from 1,475 lbs per MWh to 1,158 lbs per MWh by 2030, indicating there is significant opportunity (and need) for Longmont to identify ways to increase renewable energy and/or work with its utility to reduce the electricity emission factor. It should be noted that if both PRPA and Xcel Energy meet their renewable energy commitments, the electricity emission factor will be close to 0 lbs per MWh in 2030. However, per PRPA, this goal will only be achieved through aggressive DSM success on Longmont's behalf and is also dependent on the success of key policies and technologies. Either way, renewable energy is critical to ensuring that Longmont meets it carbon reduction goals.

Since renewable energy is responsible for over half of Longmont's GHG emission reductions (see Figure 1 and Figure 2) and it offsets electricity put on to the grid from electric vehicles, it is imperative that Longmont devise a comprehensive renewable energy plan to meet its overall GHG emission reduction goal. Examples may include a broad reduction in electricity emissions from utility-scale renewable energy or discrete projects such as the expansion of rooftop solar photovoltaic and/or community solar.

During a second phase, Longmont may also consider fuel switching and advocating for clean car policies. Both strategies are commonly pursued by other leading communities and will help further decarbonize stationary and mobile emission sources.

Appendix A

Memo: Methodology to determine top GHG reduction strategies for the City of Longmont

December 21, 2017

Background

The City of Longmont's (Longmont) 2016 greenhouse gas (GHG) emissions inventory, completed by Lotus Engineering and Sustainability, LLC (Lotus), showed a total GHG emissions value of 1,081,174 $mtCO_2e$ (metric tons of carbon dioxide equivalent, the unit by which global GHG reporting is conducted). The City desires to reduce its GHG emissions and improve the quality of life for Longmont residents. To help with this effort, Longmont has contracted Lotus to model potential GHG emission reduction strategies that will simultaneously promote secondary benefits that have been deemed desirable by City staff and stakeholders.

Lotus developed an initial list of recommended GHG reduction strategies based on extensive research. City staff and stakeholders will provide feedback on the recommended strategies via an online survey. Lotus will evaluate the final list of recommended strategies for their estimated GHG reduction potential and work with the City to develop a community-wide GHG reduction target and timeline.

Longmont will use this data to solicit feedback during an open workshop with a broader stakeholder audience, which will eventually lead to a comprehensive sustainability action plan.

Analysis Methodology

Researching Studies

Lotus reviewed 29 studies that had been prepared for Longmont, the State of Colorado, five peer communities, and two leading research organizations. The peer communities and leading organizations include:

- Boulder County
- City and County of Denver
- City of Fort Collins

- City of Lakewood
- City and County of Broomfield
- National Renewable Energy Laboratory (NREL)
- Conservation Colorado

The studies reviewed by Lotus are shown below.

List of Reviewed Studies

City/Organization	Resource	Year	Source
Boulder County	NCS Analysis	2016	Not public
Boulder County	Environmental Sustainability Plan	2012	https://assets.bouldercounty.org/wp-content/uploads/2017/03/bc-environmental-sustainability-plan.pdf
Boulder County	Western Resource Advocates Carbon Policy in Colorado Presentation, Jun	2017	Not public
Boulder County	CC4CA Policy Agenda 2016-2017	2016	Not public
Boulder County	WSP 2012 GHG Inventory	2012	Full report not public. Executive Summary available at https://www-static.bouldercolorado.gov/docs/2012_GHG_Inventory_Summary_FINAL-1-201507271631.pdf?_ga=2.175056866.1764893736.1510804426-1176060260.1510804426.
Boulder County	Sustainable Energy Plan, 2008	2008	https://assets.bouldercounty.org/wp-content/uploads/2017/03/sustainable-energy-plan.pdf
Conservation Colorado	Colorado's Climate Blueprint	2017	https://conservationco.org/climate-blueprint/
State of Colorado	Colorado Climate Plan (DRAFT)	2017	http://cwcb.state.co.us/Documents/ShortTermHomePage/CO_Climate%20Plan_10_2017.pdf
City and County of Denver	2020 Office of Sustainability Goals	2015	https://www.denvergov.org/content/denvergov/en/office-of-sustainability/2020-sustainability-goals.html
City and County of Denver	Climate Action Plan 2015	2015	https://www.denvergov.org/content/dam/denvergov/Portals/771/documents/Climate/CAP%20-%20FINAL%20WEB.pdf
City and County of Denver	80x50 Plan	2017	http://www.denvergov.org/content/dam/denvergov/Portals/771/documents/EQ/80x50/80x50%20Stakeholder%20Report.pdf
City and County of Denver	Denver Energy Plan	2015	Not public
City of Lakewood	City of Lakewood 2015 sustainability plan	2015	http://www.lakewood.org/SustainabilityPlan/
City of Lakewood	City of Lakewood Comprehensive Plan--Moving Forward Together 2025	2015	http://www.lakewood.org/uploadedFiles/Documents/Planning/CPR/Lakewood_2025_Moving_Forward_Together/Lakewood%202025_Moving%20Forward%20Together_Lakewood%20Comp%20Plan_2015(3).pdf
City of Fort Collins	Fort Collins Climate Action Plan Framework 2015	2015	https://www.fcgov.com/environmentalservices/pdf/cap-framework-2015.pdf
City of Fort Collins	Fort Collins City Plan 2011	2011	https://www.fcgov.com/planfortcollins/pdf/cityplan.pdf?1415894776
City of Fort Collins	Fort Collins Transportation Master Plan (includes Pedestrian Plan)	2011	https://www.fcgov.com/planfortcollins/pdf/tmp.pdf
City of Fort Collins	Fort Collins Bicycle Plan	2014	https://www.fcgov.com/bicycling/pdf/2014BicycleMasterPlan_adopted_final.pdf
City of Fort Collins	Fort Collins Road to Zero Waste Plan	2013	https://www.fcgov.com/recycling/pdf/RoadtoZeroWasteReport_FINAL.pdf
City and County of Broomfield	Comprehensive Plan Update	2016	https://www.broomfield.org/DocumentCenter/View/21455
City and County of Broomfield	Broomfield Sustainability Plan	2011	https://www.broomfield.org/DocumentCenter/View/9502
City and County of Broomfield	Broomfield Transportation Plan Update	2016	https://www.broomfield.org/DocumentCenter/View/15258
City of Longmont	Homeless Assessment	2017	https://www.longmontcolorado.gov/home/showdocument?id=18101. Did not provide any strategies that could also reduce GHG e
City of Longmont	Resiliency for All	2014	https://longmontcolorado.gov/home/showdocument?id=19974
City of Longmont	City of Longmont's Community Profile	2016	https://www.longmontcolorado.gov/home/showdocument?id=15097
City of Longmont	Envision Plan	2016	https://envisionlongmont.com/sites/envisionlongmont.com/files/document/pdf/EnvisionLongmont_Adopted062816_FINAL_w_ap
City of Longmont	Boulder County Trends	2017	http://www.commfound.org/files/trends/TRENDS-2017-2019.pdf
City of Longmont	2016 Sustainability Plan	2016	https://longmontcolorado.gov/home/showdocument?id=16700
NREL	Estimating the National Carbon Abatement Potential of City Policies: A Da	2016	https://www.nrel.gov/docs/fy17osti/67101.pdf
NREL	City-Level Energy Decision Making: Data Use in Energy Planning, Impleme	2015	https://www.nrel.gov/docs/fy15osti/64128.pdf

It should be noted that Lotus' initial list of recommended strategies does not include all strategies from every document above, as some documents did not include strategies pertinent to GHG reductions.

Categorizing and Vetting Strategies

Once a list of identified strategies from each plan was created, strategies were then categorized by sector (i.e., the GHG emissions area where the strategy will have an impact) and strategy type (i.e., the type of activity, project, or program the strategy proposes).

Strategy sectors were identified as Buildings, Oil and Gas, Solid Waste, Transportation, and Other. Strategy types may include topics such as energy efficiency programs, comprehensive building codes, etc.

Strategies were then evaluated for their potential to reduce GHG emissions (e.g., low, medium, high, and unknown), the ease of implementation for the City, the degree to which the City has control, and the timeline for implementation. Each strategy's potential for GHG reduction was estimated based on data provided in researched studies and Lotus' previous modeling experience. All other criteria were estimated based on Lotus' experience.

Strategies were further vetted against secondary benefits deemed desirable by Longmont's stakeholder team. These secondary benefits include:

- Promote environmental justice
- Reduce low-to-moderate income (LMI) energy burden
- Improve public health and air quality
- Reduce costs for end users
- Build economic development
- Prevent pollution

Lotus used the following definitions for each secondary benefit:

- Promote environmental justice: These strategies have the potential to help vulnerable populations reach greater equity with non-vulnerable populations.
- Reduce LMI energy burden: Energy burden is defined as the ratio of money spent on energy bills versus total income. These strategies have the potential to reduce LMI energy costs, and thus, this ratio.
- Improve public health and air quality: These strategies have the potential to reduce emissions of toxic air and water contaminants (particularly indoors), reduce chemical exposure, and improve health and safety.
- Reduce costs for end users: Regardless of the implementation cost, these strategies may reduce final costs to the end user.
- Build economic development: These strategies could bring outside dollars into the community and/or encourage the community to invest their money in the local workforce and businesses.

- Prevent pollution: These strategies have the potential to reduce waste generation, emitted pollutants, and potentially related toxicity. There may be a link to public health impacts, but not necessarily.

Developing Initial List of Recommended Strategies

Vetted strategies that were identified as having a medium or high GHG reduction potential, as well as those that promoted environmental justice and reduced the LMI energy burden were identified and highlighted. These two secondary benefits were selected as key vetting criteria since they are part of Longmont's core sustainability vision. In addition, the remaining four secondary benefits were frequently achieved by each of the suggested strategies and did not need to be vetted against separately.

Strategies that hit at least two of the key criteria (e.g., a strategy that has a medium GHG reduction potential and reduces the LMI energy burden or a strategy that promotes environmental justice and reduces the LMI energy burden), were determined to be of high value to Longmont. These strategies were included in the initial list of recommended strategies.

The initial list of recommended strategies is shown below. Strategies shown in green are already underway to some degree. Additional detail can be referenced in the spreadsheet titled *FINAL_Recommended Strategies for Modeling_122017*.

List of Suggested Strategies for Longmont's Consideration

Sector	Strategy Type	Strategy	Promote Environmental Justice	Reduce LMI Energy Burden	Improve Public Health	Reduce Costs for End Users	Build Economic Dev.	Prevent Pollution
Buildings	*Comprehensive Building Codes*	Use updated building code and enforce		X	X	X	X	
		Develop 'beyond' building code		X	X	X	X	
	Energy Efficiency Programs	Implement strategies for achieving deep carbon reductions in existing buildings	X	X	X	X	X	X
		Implement/expand income qualified energy efficiency program	X	X	X	X	X	X
	Renewable Energy Adoption	Develop a comprehensive 100% renewable energy plan for Longmont's just transition to a clean energy economy	X		X	X	X	X
	Improve Electric Grid	Encourage practices that reduce transmission and distribution losses	X		X			X
		Accelerate and implement smart grid projects		X	X	X	X	X
Oil & Gas	*Expand Regulations and Policies*	Encourage the adoption of local, state, and federal regulations and policies that reduce oil and gas impacts	X		X			X
Transportation	*Multimodal transportation options*	Reduce single-occupancy vehicle travel	X		X	X	X	X
		Encourage non-vehicle ownership in all households	X	X	X	X		X
	Clean Car Standards	Advocate for regional Clean Car Standard/Fuel Efficiency Standards	X		X		X	X
	Electric Vehicles	Increase adoption of electric vehicles through vehicle incentives and improved infrastructure	X		X		X	X
	Transit	Address barriers to increase access and use of public transit, especially for underserved communities	X	X				
	Biking and Walking	Complete first mile/last mile connections with biking and walking	X		X		X	X

Other	*Commit to ambitious goals*	Commit to carbon neutrality goal	X		X		X	X
		Commit to GHG reduction goal	X		X		X	X
	Support policy, legislation, regulation	Support federal, state, and local policy that addresses climate change	X		X		X	X
	Support statewide funding	Support statewide funding for weatherization	X	X	X	X	X	X

This list will be reviewed by Longmont's stakeholder team for feedback and input. Based on feedback, the consulting team will develop a list of final strategies to model and around which targets can be set for reducing GHG emissions.

Appendix B

Longmont Strategies Survey Results

Key takeaways:

- Survey responses illustrated that identified strategies were for the most part in line with the stakeholder's priorities. Strategies that were most favored included those that provide energy efficiency programs for low-income folks, homeowners, and business, strategies that improve public transit, and those that drive towards 100% renewable energy. Strategies that were least favored were encouraging non-vehicle ownership.
- Most timelines and goals were seen as on track. Goals related to GHG reduction and expanding LMI energy programs were commonly ranked as 'too low,' and goals that related to new building code updates and 100% RE were seen by many respondents as 'too high'
- Greatest challenges to implementation were perceived as funding, staff time, economic factors, tracking accurate data, and gaining public interest/support (particularly in GHG emissions)
- 'Quality of life stands' out as the guiding principle that drives this work and public participation; 'climate change' comes in second.

Top strategies based on questions (1) and (5):

Building energy efficiency

- Implement strategies for achieving deep carbon reductions in existing buildings
  - Use updated building code and enforce
  - Report and benchmark energy use
  - Develop 'beyond' building code
  - Retro-commissioning
  - ~~Fuel switching~~
- Implement/expand income qualified energy efficiency program – LPC, Energy Outreach Colorado
- ~~Support Energy Efficiency Resource Standard state law by 2018~~

Electric Grid

- Accelerate and implement smart grid projects
- Encourage practices that reduce transmission and distribution losses

Renewable Energy

- Develop a comprehensive 100% renewable energy plan for Longmont's just transition to a clean energy economy – City committed to this

Oil and Gas

- Encourage the adoption of local, state, and federal regulations and policies that reduce oil and gas impacts through adoption and enforcement of leak detection and repair
  - ~~Expand regulations to reduce emissions from oil and gas~~

Transportation

- Increase the adoption of electric vehicles through vehicles incentives and improved infrastructure
- Reduce single-occupancy vehicle travel
  - Address barriers to increase access and use of public transit, especially for underserved communities - Complete first/last mile connections with biking and walking, how safe is transit, how accessible is transit
  - Develop multimodal transportation system - implement bus rapid transit, multimodal transportation is part of Envision

Suggested supporting goals (more qualitative):

1. Commit to GHG reduction goal
2. Commit to carbon neutrality goal
3. Support clean energy policies to support clean energy action agenda in Colorado
4. Support state level action that will reduce carbon impacts and support the development of clean energy options for all communities
5. Support stringent state carbon reduction goals

1) Strategies identified for Longmont were ranked 1-10 by survey respondents. Strategies were ranked in the following order:
   1. Develop a comprehensive 100% renewable energy plan for Longmont's just transition to a clean energy economy
   2. Implement strategies for achieving deep carbon reductions in existing buildings
   3. Increase the adoption of electric vehicles through vehicles incentives and improved infrastructure
   4. Implement/expand income qualified energy efficiency program
   5. Commit to GHG reduction goal
   6. Accelerate and implement smart grid projects
   7. Commit to carbon neutrality goal
   8. Complete first/last mile connections with biking and walking
   9. Reduce single-occupancy vehicle travel
   10. Use updated building code and enforce
   11. Encourage the adoption of local, state, and federal regulations and policies that reduce oil and gas impacts
   12. Develop 'beyond' building code
   13. Address barriers to increasing access and use of public transit, especially for underserved communities
   14. Encourage practices that reduce transmission and distribution losses
   15. Support federal, state, and local policy that addresses climate change
   16. Advocate for regional Clean Car Standards/Fuel Efficiency Standards
   17. Support statewide funding for weatherization
   18. Encourage non-vehicle ownership in all households

2) Respondents provided additional comments on which initiatives they think would have the greatest level of public support:
   - 'Encouraging non-vehicle ownership' was noted as not realistic by several commenters
   - Public-transit based programs and other programs that have a public face, such as LMI energy efficiency programs, were noted as being well-supported by the public
   - Several respondents indicated that they think that '100% RE' will be supported by the public, especially when combined with a 'healthy community' narrative
   - Policies surrounding beyond building codes and deep carbon reductions in buildings were generally favorable by the public, as long as they aren't tied to significantly increased costs

- Cost of living and cost of energy was referenced by many respondents as a key factor in public support

3) Respondents were asked whether targets were too low, too high, or on track.
    a. In general, most targets were seen by respondents as being 'on track.' There were the following notable exceptions:
        i. Develop 'beyond' building codes, GHG reduction of up to 100% in the building sector for new construction by 2030
            1. 40% of respondents thought this target was 'too high'
        ii. Implement/expand income qualified energy efficiency program, GHG reduction of up to 15% in the existing building sector by 2020
            1. 47% of respondents thought this target was 'too low'
        iii. Develop a comprehensive 100% renewable energy plan for Longmont's just transition to a clean energy economy, increase to 100% renewable energy by 2030
            1. 56% of respondents thought this target was 'too high'
        iv. Reduce single-occupancy vehicle travel, mode shift resulting in 25% reduction in SOV travel by 2025
            1. 33% of respondents thought this target was 'too high'
        v. Encourage non-vehicle ownership in all households, reduction of up to 25% in vehicle ownership by 2025
            1. 67% of respondents through this target was 'too high'
        vi. Commit to GHG reduction goal, GHG reduction of up to 80% in all sectors by 2050
            1. 44% of respondents thought this target was 'too low'

4) Respondents generally agreed with the vetting of strategies with secondary benefits. Main comments were that developing a 100% RE plan and improving building codes will not cause an immediate impact on end-user costs or LMI energy burden. One respondent stated that they did not understand the question.
    a. Building code policies may have a long-term reduction in LMI, and cost to end user, but savings will not be immediate with requirements to replace/upgrade appliances, and anticipated increased costs in working with, negotiating, receiving approval from building departments and increased costs of review by building departments to enforce increased requirements. Not to say these aren't viable or necessary methods - but that industry, residents may consider that the costs to meet these codes will be higher with a longer-term RO

b. The definition of prevent pollution does not include reducing waste generation and increasing recycling (although waste generation creates air emissions and has the potential to pollute the water.
c. Develop a 100% renewable energy plan: This will not decrease the cost for end users. - Smart Grid Projects: This will not reduce LMI or decrease the cost for the end user

5) This question addressed the additional strategies commonly pursued by communities. In general, the additional strategies listed had a high rate of approval for 'Should be pursued by the City of Longmont.' Approval of these strategies ranged from 73% of respondents, up to 100% of respondents thinking Longmont should pursue these additional strategies. Additional strategies with overwhelming support (more than 75% of people chose them). Includes the entire list of suggested strategies with the exception of Form a Western Regional Energy Market.
    a. Report and benchmark energy use
    b. Retro-commissioning
    c. Support clean energy policies to support clean energy action agenda in Colorado
    d. Fuel switching
    e. Expand regulations to reduce emissions from oil and gas
    f. Develop multimodal transportation system
    g. Implement bus rapid transit
    h. Support state level action that will reduce carbon impacts and support the development of clean energy options for all communities
    i. Support stringent state carbon reduction goals
    j. Support Energy Efficiency Resource Standard state law by 2018

6) This question addressed the level to which respondents thought a perceived challenge would be significant (responses for 'Not Challenging' and any categories with a response rate below 20% not included here):
    a. Funding the program or policy—50% saw as 'moderately challenging,' 36% saw as 'very challenging'
    b. Finding staff time to implement—50% saw as 'moderately challenging,' 29% saw as 'very challenging'
    c. Getting community interest and/or support—79% saw as 'moderately challenging'
    d. Dealing with old and/or aging infrastructure—43% saw as 'moderately challenging', 50% saw as 'very challenging'

e. Dealing with general economic factors (outside of funding individual programs)—62% saw as 'moderately challenging,' 23% saw as 'very challenging'
f. Managing the perception of inconvenience—29% saw as 'moderately challenging,' 43% saw as 'very challenging'
g. Managing the perception of lack of flexibility in changing or updating policy—64% saw as 'moderately challenging'
h. Getting participation from key stakeholders—64% saw as 'moderately challenging'
i. Dealing with population growth and increases in demand for related activities and services—46% saw as 'moderately challenging,' 23% saw as 'very challenging'
j. Getting activity data that is difficult to track and collect—25% saw as 'moderately challenging,' 50% saw as 'very challenging'
k. Managing the fear of change/difficult to change behavior—62% saw as 'very challenging'
l. Dealing with a lack of interest in reducing GHG emissions—46% saw as 'moderately challenging,' 23% saw as 'very challenging'

7) Ranking of guiding principles for implementing sustainability initiatives was as follows:
   a. Quality of life (62.5% ranked as first guiding principle)
   b. Climate change (40% ranked as first guiding principle)
   c. Attracting new talent and business
   d. Improving public health and the environment
   e. Other (see answers to question 8)
   f. Competitiveness among other leading cities nation-wide
   g. Moral/ethical responsibility
   h. Mitigating potential impacts on tourism/industry
   i. Environmental justices

8) When asked about personal motivations to participate in this work, most respondents stated that they had a moral/ethical responsibility or strong feelings about climate change, followed by a desire to reduce costs for users, and lastly, strong opinions on environmental justice issues.